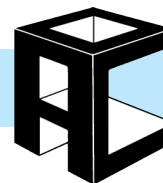


Guide for Laser Cutters



Advanced
Output
Center

Laser Cutter Information



	Trotec Speedy 400	Trotec Speedy 400	Universal PLS6.150D
Max Sheet Size	39" x 24"		32" x 18"
Machine Watts	120w CO2	120w CO2 50w Fiber	150w CO2
Location	Two in AOC		
	One in CDFS	One in CDFS	One in CDFS
Advanced Output Center location: Sullivan Rm 1232 Columbus Digital Fabrication Studio location: Columbus Rm 120			
Pricing	Free		
Applicable Fines	\$50 minimum fine for irresponsible cutting, damage, etc See fines section for more details.		
Materials	See Approved Materials List		
File Types	Illustrator (.ai) vector files; AutoCAD (.dwg) files		
Access:	Self-serve, open to currently enrolled students, active faculty and staff; Users must be certified prior to use; See access section for details.		
Special Features			
iCut software: (camera assisted cutting)			
Rotary Attachment	X (AOC ONLY)		
Fiber Laser (better for metal)		X	
Vacuum Table (Keep paper flat)	X (AOC ONLY)		

Accessing the Laser Cutter

Certifications

- Before using the laser cutter, you must first complete a certification session. Currently enrolled students, faculty and staff can be certified for laser cutting.
- The information covered during certifications will change as software and hardware are updated or reconfigured. To keep users up to date on laser cutter techniques and policies, certifications must be renewed every two years.
- To sign up for the certification course, please visit our website.

Reservations

- Reservations must be made in person through a lab monitor at least 15 minutes before the time being reserved, and no more than 2 weeks in advance.
- Reservations can only be made in 30-minute blocks. You can reserve up to 12 sessions of 30-minutes each per week. There is no limit for walk-in use.
- Reservations are non-transferable from one person to another. You can only make and use reservations for yourself.
- Reservations can be rescheduled if you notify lab staff at least 1 hour in advance of your reserved timeslot.
- You will be given a 10-minute grace period to show up for your reserved time slot. After the grace period expires, your slot will become available for walk-in users.
- There is a \$10 fee for not showing up for a reservation or for canceling with less than 1 hour notice.
- In the unlikely event that your reserved time slot must be canceled due to equipment malfunction or other unforeseeable issues, you will be notified as quickly as possible and given the option to make a new reservation at the earliest available time slot.
- In the event that a laser cutter is taken offline, it will not be available for reservation until it is operational again.

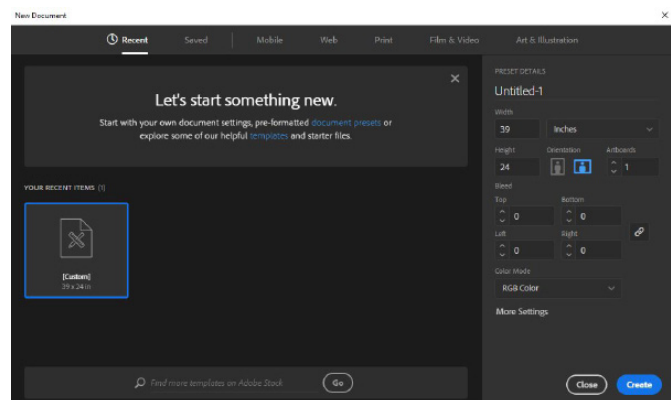
Walk-ins

- All certified users are able to walk in and use either laser cutter when it has not been reserved in advance, or when a no-show for a reservation occurs. Walk-in users must check in with a lab monitor prior to cutting; additionally, it is the user's responsibility to check out with the lab monitor after cleaning up.
- Walk-in time is generally discouraged for long cuts as any user could reserve time 15 minutes from the time you start.
- Walk-in users can use any available time, up to when the next reservation starts or 30 minutes before the lab closes, whichever comes first.

Document Preparation

Set up your document in Illustrator

- In Illustrator, select File->New..
- For the **Trotec** laser cutter set a maximum "Width" of 39" and "Height" of 24".
- Sizes smaller than 39"x24" are compatible with the Trotec as well.
- Set "Color Mode" to RGB
- Click OK

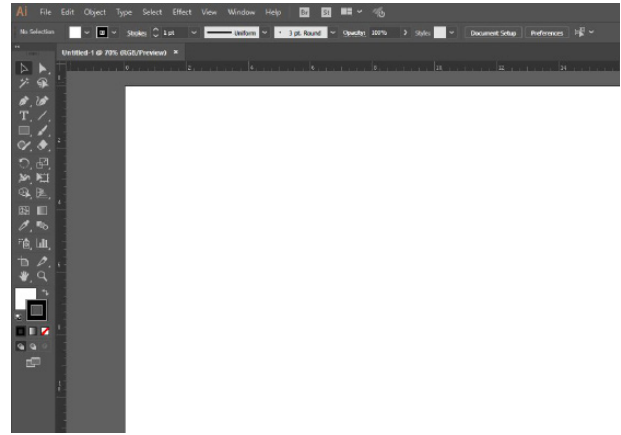


Turn on the Rulers:

- Select View -> Rulers -> Show Rulers

Set the Guides:

- Set a guide line to the bottom edge of your material and the right edge of the material.
- We also recommend you place a guide at a 1/4" inch from each edge of the document that your material will touch. This will inset the design slightly so it is completely contained.



Preparing your graphics in Illustrator

Cut Type	Graphics Requirements	Single/Multipass	Order	End Result
Raster Engraving	- Filled Shapes or text - Images (jpg, bitmap, etc) - Lines with heavy stroke weights (+0.01pt) - Gradations	Multi-pass (like an inkjet printer)	Before Vector Lines following color table	Engraved area (Power is limited to prevent cutting through)
Vector Engraving	Lines with these properties 0.01pt stroke weight - Aligned to center - No brushstrokes - No dashed lines - No compound paths - No clipping paths	Single pass (following vector path)	Dependent on color	Engraved line (Power is limited to prevent cutting through)
Vector Cut				Through-cut line (Power is increased to cut through)

The laser cutter can make three different types of cuts; see the table above for an overview of each. All cuts can be sent from the same Illustrator file. Graphics in the file are grouped into different colors, which allows the laser cutter to distinguish different cuts from one another. Color are also used to determine the order in which vector cuts and engravings take place. When designing your file, it is best to skip those colors unless you know you will use that machine.

TROTEC COLORS				
Color	Order	Red Value	Green Value	Blue Value
Black	1st	0	0	0
Red	2nd	255	0	0
Blue	3rd	0	0	255
Navy	4th	51	102	153
Cyan	5th	0	255	255
Green	6th	0	255	0
Ivy Green	7th	0	153	51
Forest Green	8th	0	102	51
Brass	9th	153	153	51
Tan	10th	153	102	51
Brown	11th	102	51	0
Purple	12th	102	0	102
Violet	13th	153	0	204
Magenta	14th	255	0	255
Orange	15th	255	102	0
Yellow	16th	255	255	0

NOTE: Use the exact RGB color values listed in the table above, and make sure your Illustrator document is in the RGB color mode (NOT CMYK) when file prepping for the laser cutter; otherwise the laser cutter will not read your file!

When the laser cutter runs a file, it automatically processes raster engraving first, before vector engravings and vector cuts. It will then process all vector cuts and vector engravings as one group--this is where color should be used to control the order of cuts. In the example below, black has been designated for raster engravings, red for vector engraving, and green for vector cutting.

(The colors used here are only an example; the same cuts could be made with different colors.)

By setting up the vector and raster engravings to go first, we'll keep the material stationary until the outline cut is made. When the file is run, the cuts and engravings will happen in this order.

1. Raster engraving (black)
2. Vector engraving (red)
3. Vector cut (green)

When setting up a file for laser cutting, use a different color any time you want to assign different settings or affect the cutting order of a group of cuts.

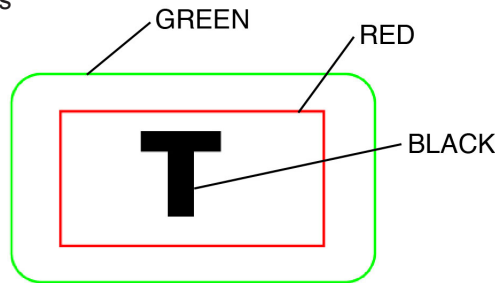


Fig. 1: Source File

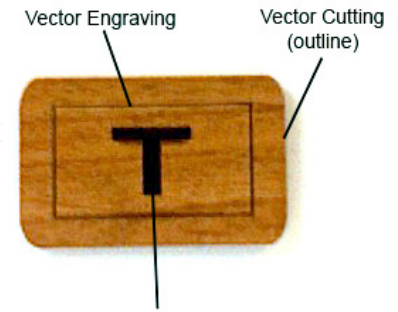


Fig. 2: Finished Cut

NOTE: A good technique for keeping your cuts in order is to assign your last cut to the last color on the list, and work your way backwards towards the first cut.

Term Explanation for Power Settings

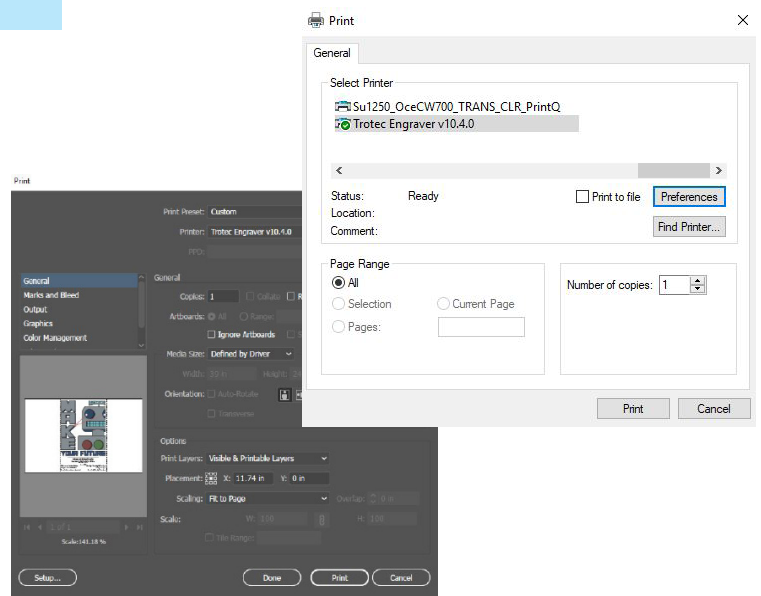
- Pen/Process Mode
 - CUT = vector cuts AND vector engravings
 - ENGRAVE = raster engravings
 - SKIP = ignore this color
 - POSITIONING = Trotec Only for iCut Software
- Power: The power setting for the laser beam, ranges from 0-100%. More power = deeper cut; less power = shallower cut. You can use decimal places in this range.
- Speed: The speed of the laser head, ranges from 0-100%. Less speed = deeper cut; more speed = shallower cut.
 - Speeds over 4% may cause wavy cuts in small or intricate lines. **DO NOT EXCEED 10% FOR VECTOR!**
- Cut Only - Hz (Pulses per inch): Spacing between laser pulses
 - Low Hz (1000-2000) = not much burning
 - Medium Hz (2000-4000) = smoother cut resolution, some burning
 - High Hz (4000-5000) = smoothest resolution, more burning

Power Settings

Use the laser cutter control panel to assign power settings and cut types to the colors in your file.

Assigning Power Settings

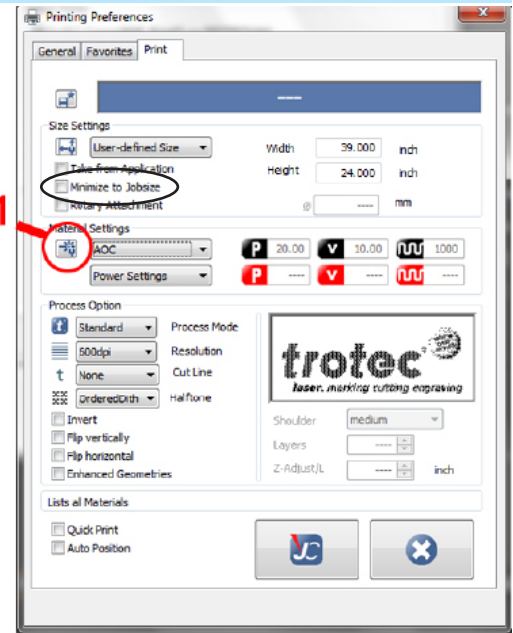
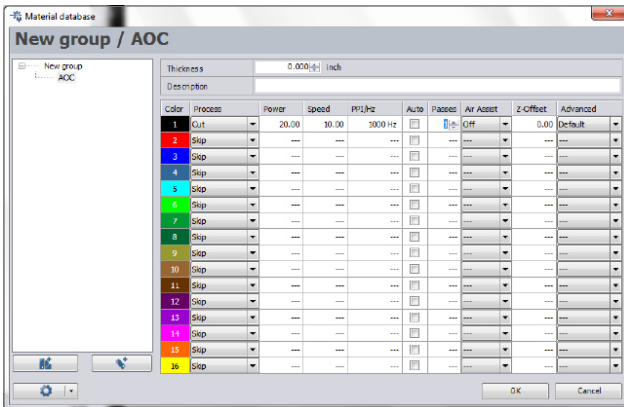
- In Illustrator, select File-->Print...
- Make sure the "Printer" is set to "Laser Cutter"
- In the lower left corner of the "Print" dialog box, click the "Setup..." button, then "Preferences".
- The laser cutter control panel will appear. Now you can assign the power settings for the different colors in your file. Power settings are available online on our website listed at the bottom of the guide. Samples are visible next to the laser cutters.



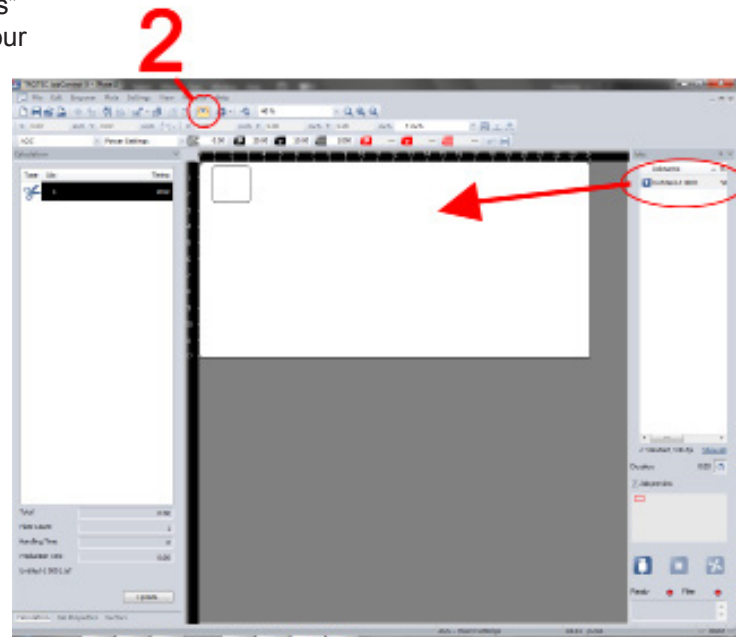
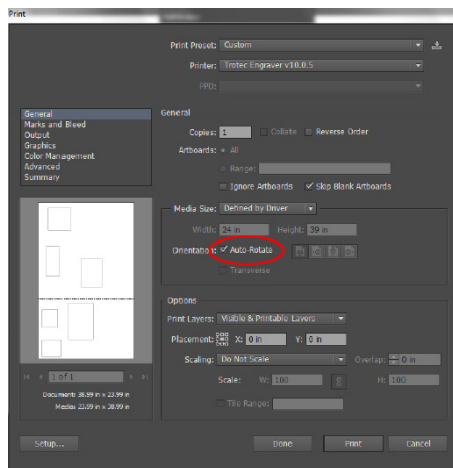
Trotec Laser Settings

Assigning Power Settings

- Click the material settings button marked as **#1** in the image to the right.
- In the “Material Database” window, select the desired row and assign your POWER, SPEED and Hz/PPI for your desired material. You can use the power setting available on the AOC website.
- When you are finished assigning settings for that color, set your “Process Mode”.
- Click “OK” in the laser cutter control panel.
- Before leaving this window, if you select “minimize to jobsite”, the laser cutter will only send cuttable data vs the entire art board. This allows for greater freedom when placing your design. This step is optional.
- Click “JC”, then “Print” in the second dialog window.



- In the first print dialog, make sure that the Auto-Rotate is selected, and that the preview looks rotated 90 degrees counter-clockwise (don't worry, it will cut correctly).
- Click Print and switch to the JobControl software
- Find your file name on the right hand side under "Jobs" and drag the file into the work space. If you printed your file with minimize to job size, place it where you want, otherwise place a 39"x24" file at 0,0
- Toggle visibility using the eye icon (#2 in image)

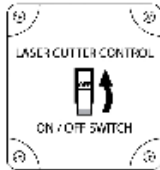


NOTE: It's a good idea to have a lab monitor double check your settings before sending. While the won't guarantee you'll get the exact cut results you want, it will help prevent files with dangerous settings from being sent!

Focus Settings and Printing on Trotec Laser Cutter

After you have prepared your file, the machine and your material must be prepared for cutting. Since the laser actually burns through the material it cuts and engraves, it is very important to only use approved materials and to watch the cutter at all times during the operation in case of fire. Cutting the wrong materials or using the cutter irresponsibly can result in harm to you, the laser cutter and the lab staff, as well as generate fines to your student account.

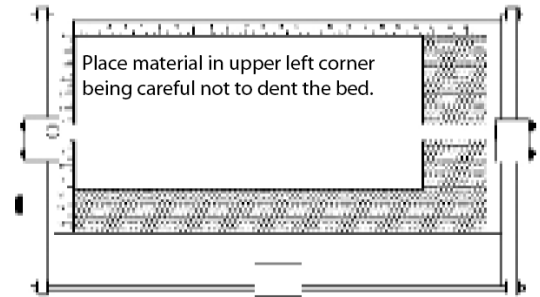
1



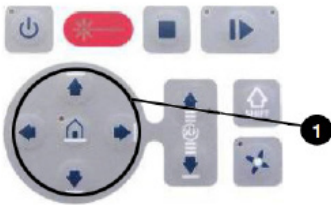
Turn on the wall switch next to the ventilation pipe.

Turn key on the machine to the "On" position.

2



3



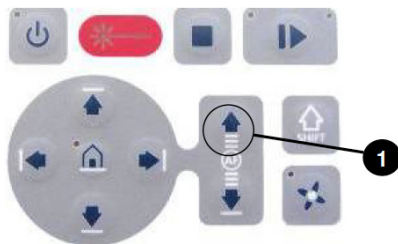
Move the processing head over the material to be engraved by means of the positioning keys X/Y.

4



Hang the focus tool on the external ring of the working head so that the focus tool can move unhindered.

5



Move the working table upwards by pressing the Z positioning key. While doing this carefully observe the focus tool. Before the focus tool reaches the work piece, move the working table upwards only very slowly and step by step by briefly tapping the positioning key, until the tool tilts to the side or falls off.

Remember to set the focus anytime you start using the machine, as well as when you switch to a material with a different depth.

NOTE: Before using the machine, have a lab monitor check to make sure the cutting table is aligned properly.

Printing the file

- Make sure the laser cutter is turned on
- Before printing you should have a lab monitor check your focus and driver settings
- Once your settings are checked, click "Print" to send the file to the laser cutter
- Sync the laser software with the laser cutter using the USB icon in the lower right corner of the Job Control (see image)
- With the enclosure lid raised, pushing start will trace out the path without cutting. Make sure the cuts are in the proper area; adjust the file if needed.
- Now hit "Pause" and close the enclosure.
- With the lid closed, hitting "Start" will cause the laser to actually cut the file.
- You must watch the cutter output your entire file.

DO NOT LEAVE THE CUTTER RUNNING UNATTENDED!

- If you need to temporarily stop cutting, hit the "Pause" button and WAIT FOR THE LASER TO STOP CUTTING. The cutter must finish the last line it started before pausing; if it is a long line or a slow cut, it can take several minutes for the cutter to stop.



(Located in lower right hand corner)

Laser Cutter Safety

The most common safety risk while using the laser cutter comes from fire. Anyone using the cutter must sit in front of it and watch their entire job until it is finished. Failure to do so may result in fines, damage to the machine, and possible bodily harm to the user and lab employees. Anyone using the laser cutter must wear supplied protective eyewear.

NOTE: If at any time during cutting you notice anything unusual, shut off the machine immediately! This includes fire, loose parts, warped materials, or anything that looks or sounds strange to you...WHEN IN DOUBT, SHUT IT OFF!

General Safety

- Eye-protection in the form of laser-rated safety goggles is required by all users. Safety goggles are available for check out from the lab monitor. Please note regular glasses (even safety glasses) are not adequate.
- When using a flexible material such as paper, the edges must be held down securely with tape.
- **Cellphones/texting, and laptop or desktop use are not allowed while monitoring a cut. Headphones and reading a book are OK!**
- After your job finishes cutting, the enclosure lid must be left shut for at least 10-15 seconds to allow for smoke and fumes to be exhausted.

Responding to Small Fires/Flare-ups

- Watch your job carefully. If you notice a small flare-up while your job is being processed, hit the "Pause" button, and wait for the laser head to clear the table. The wall switch can also be used to immediately stop the laser cutter.
- Open the enclosure lid, and spray the flare-up out using the water bottle on the side of the machine if the flare-up does not go out on its own.
- Close the lid, and hit the "Pause" button if you wish to continue where it left off.
- If you notice that your material is being scorched or is producing visible smoke or flame, either lower the power setting, increase the speed setting or re-check your focus.

NOTE: Whenever the "Pause" button is hit, the laser will finish whichever path it is in the process of completing before stopping. This can, in some cases, take up to several minutes.

Excessive Fire/Smoke

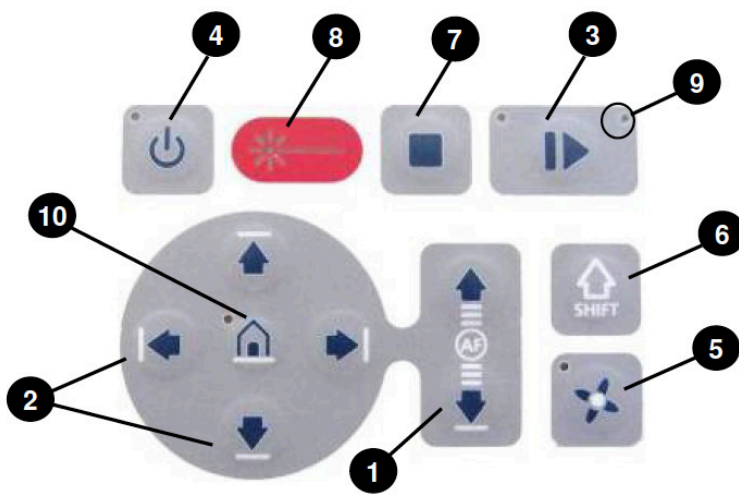
- If your job begins to produce large flames and/or excessive smoke, immediately notify the nearest lab staff member.
- There is a fire extinguisher located near the door inside the laser cutting room, as well as one on the right wall immediately outside the laser cutting room.

Fines

Improper activity while cutting Cell phone use Laptop or computer use Walking away from machine while operating Cutting without checking in Failure to clean machine after cutting Failure to vent material for 15 seconds after cut has finished	1st: Warning 2nd: \$15 3rd: \$50
Unsafe laser practices Cutting on-approved or hazardous materials Improper laser settings Improper lens focus	1st: Warning 2nd: \$25 3rd: \$50
Producing fire or excessive smoke that requires staff intervention	1st: \$25 2nd: \$50 3rd: \$100
Damage to machine	Cost of repair / replacement

Laser Cutter Components & Controls

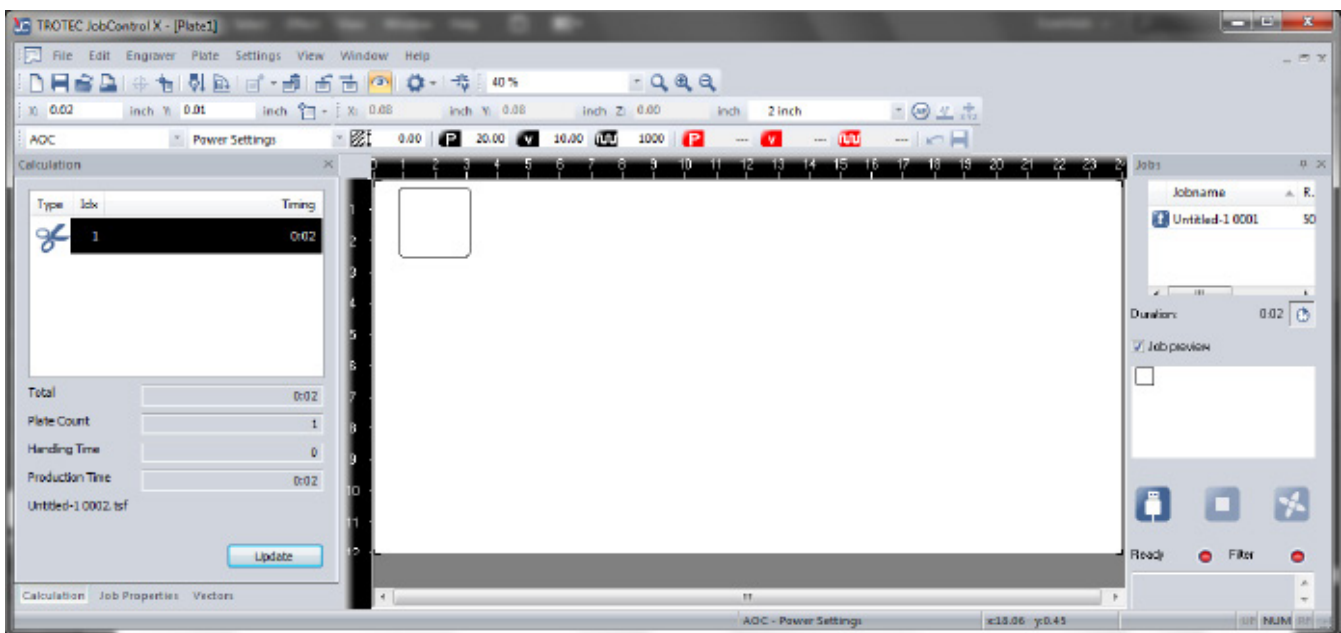
Familiarize yourself with the laser cutter components shown below. Before cutting, all users should have a basic understanding of how the laser cutter works, as well as how to focus the laser and start, pause and resume cut jobs.



1. Z Axis controls - Use to raise and lower the bed for focusing
2. X/Y Axis controls - Use to move the laser head around the table
3. Start / Pause / Repeat - Use to start or pause a job
4. Standby mode - Switches laser into standby
5. Exhaust - (NOT USED)
6. Shift - (NOT USED)
7. Stop - Stops whole job.
8. Status Indicator Laser Beam - Alerts when laser is in use
9. Status Display - Current Status of machine
10. Home - Will home all axes

Time Estimate

If you want to know how long a file is going to take to cut, send your file as normal, drag your file into the work space and click "Update" in the lower left hand window under "Calculation". The time will update with an estimation.



Advanced Cutting Options

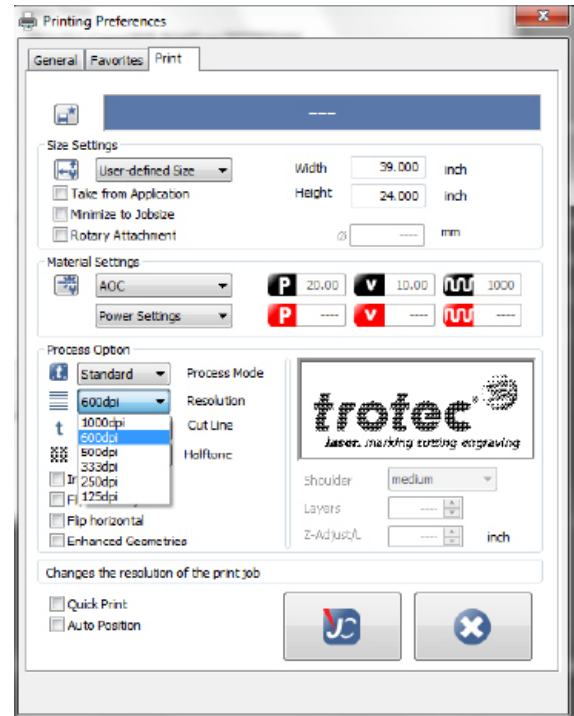
On the Trotec you can control the DPI of raster engraving images. The higher the DPI, the slower your cut will take but the better the quality. Use a lower DPI to get images engraved faster.

150dpi = fastest, lowest resolution

600dpi = default dpi

1000dpi = slowest, highest resolution

Image dpi is set in the driver, along with the power and speed settings.



Color Grouping Raster Engravings

Files with multiple raster engravings can also be sped up by strategically grouping raster engravings by color. Raster engravings of the same color are essentially treated as a single shape when they are horizontally aligned. The two identical color circles below (Fig 1) are engraved in the same set of passes. To do this, the laser must spend a good amount of extra time passing over the empty space in between them; in face, the two circles would take exactly as long to engrave as the elongated circle (Fig 2), even though they have a much smaller engraving area.

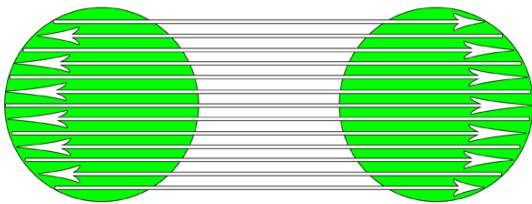


Fig. 1



Fig. 2

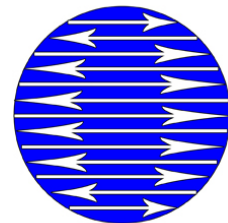
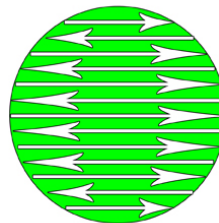


Fig. 3

To avoid excessive raster engraving times, group separate horizontally aligned raster shapes into different colors when there is a substantial distance between them (Fig 3). This way the laser won't have to spend extra time passing over the empty space between.

Laser Cutter Materials

All materials used on the laser cutter must be approved by the lab management prior to cutting. Some materials can be extremely toxic and/or damaging to the machine. Reflective materials should never be cut, as they can cause the laser beam to reflect and bounce out of the enclosure. Please do not attempt to cut any unapproved materials; there is a \$50 fine for cutting unsafe materials. If you have questions about a new or unapproved material, please ask a lab monitor.

Approved Materials

Anything in this section is safe to cut from any vendor. No need to speak with lab staff before purchase.

This list is constantly being updated. **For the most up to date list, please visit our website.**

Material	Raster Engraving	Vector Engraving	Vector Cut
Corrugated Cardboard	OK	OK	OK
Uncoated Paper	OK	OK	OK
Chipboard/Matboard/Museum board	OK	OK	OK
Resale Acrylic	OK	OK	OK
Interior Plywood	OK	OK	OK
Balsa Wood / Basswood	OK	OK	OK
Hardwoods (Domestic Only)	OK	OK	OK
Arries Board (Resale MDF)	OK	OK	OK
Masonite	OK	OK	OK
Resale Cork	OK	OK	OK
Resale Vegetable tanned leather	OK	OK	OK
Resale Muslin	OK	OK	OK
Unmounted Linoleum	OK	OK	OK
Glass	OK	OK	NOT OK

Special Condition Materials

Materials listed from here must be bought from the vendor listed or after approval from an lab manager. Receipts must be presented upon request or you will not be able to cut the material in question.

Material	Raster Engraving	Vector Engraving	Vector Cut
Non-Resale Acrylic <i>Vendor: Inventables, McMaster-Carr, Peterson's Plastics</i>	OK	OK	OK
Mirrored Acrylic <i>Vendor: Inventables, McMaster-Carr, Peterson's Plastics</i> Other notes: Material must be masked off and mirrored side face down during the cutting process.	OK	OK	OK
Wool Felt (Grade F10) <i>Vendor: McMaster</i> Other notes: Raster engraving can create very smelly cuts. Please bag off all materials after cutting. Extended ventilation also highly suggested.	OK	OK	OK
Unglazed Porcelain Tile <i>Vendor: Any</i> Other notes: Engraving this material produces a very bright point at the beam. Do not look directly at the beam.	OK	OK	NOT POSSIBLE
Rowmark Plastics <i>Vendor: Inventables</i> Other notes: The following Rowmark products are okay; LaserMark, LaserMax, Flexibrass/Flexicolor, Textures, ADA Alternative	OK	OK	OK
Non-Resale Fabrics Other notes: Material cannot be dyed unless proof of natural dyes.	OK	OK	OK

Laser Cutter Materials Continued

BANNED MATERIALS

The materials listed here are banned from laser cutting. If you attempt to cut anything listed below you will be issued a \$50 fine. This list is constantly being updated. **For the most up to date list, please visit our website.**

Material	Banned Reason
PETG, PET	Along with other emissions, is known to emit Benzene which is known to cause cancer.
Polystyrene	Known to emit styrene fumes.
ABS	Emits cyanide gas and tends to melt.
PVC	Emits chlorine gas during a cut.
Bending Plywood	Bends into the path of the laser carriage during operation.
Tropical Hardwoods	A lot of tropical hardwoods have toxins in the wood.
Corian	Creates a fine grit inside the laser bed and will grind down equipment
Casting Wax	Melts a lot.
Nylon	Emits toxic fumes.
Vinyl	Emits chlorine gas during a cut
Delrin	Along with other emissions, is known to emit Benzene which is known to cause cancer.
Foamcore	Foamcore is an expanded polystyrene and is known to emit styrene fumes when cut.